



NESDIS HYPERSPECTRAL *COMPRESSION* TEAM MEETING

BACKGROUND ON THE NESDIS HES HYPERSPECTRAL *COMPRESSION* TEAM And ROLE for GOES R *HES Data Compression*

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SSMC Building 2,
Silver Spring, MD

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GOES R Notional Baseline

Background

- NESDIS Team Formed to Explore Compression of GOES R Era HES Sensor Hyperspectral Data.
- January 25, 2002 was First Compression Team Meeting with Papers.
- Compression Studies initiated after March 2001 AMS paper by Allen Huang and Paolo Antonelli on the potential for high resolution IR compression

And

- NESDIS OSD Communications engineering studies showing need for HES Data Reduction for GOES R Data distribution.
- Compression Team Goals:
 1. Determine optimum approach to GOES R Hyperspectral compression (**Principal Components, Wavelets, Hybrid Wavelets, etc**)
 2. Develop Results Acceptable to NOAA and Appropriate Communities
- Team has worked since its first January 25, 2002 meeting, coordinating by telephone every ~8 weeks as needed.
- **Today's Team's Presentations Reflect Compression Work Using AIRS Simulated and Real Data (LW, MW,SW bands).**

NESDIS GOES R Hyperspectral Compression Team Members:

Tim Schmit Co-Lead	NESDIS ORA, located at Univ of Wisconsin in Madison
Roger Heymann Co-Lead	NESDIS OSD Silver Spring, MD
Dr. Allen Huang, Dr. Bormin Huang, Dr. Jun Li, Kevin Baggett	CIMSS, University of Wisconsin
Dr. Hsieh (Steve) Hou	The Aerospace Corp, Los Angeles, CA
Dr. Pen-Shu Yeh	NASA GSFC, Greenbelt , MD
Dr. Mitch Goldberg, Dr. Walter Wolf, Dr. Lihang Zou	NESDIS ORA
Dr. Claude Williams	NESDIS NCDC, Ashville, NC

Role of GOES R Data Compression

- GOES R era first launch scheduled launch Yr 2012 Timeframe
- GOES R's two principal atmospheric sensors (in terms of data rate):
 - Imager (ABI)
 - Hyperspectral sounder suite (HES)
- **ABI and HES will have Significantly Greater Data Rates than Current GOES Sensors**

DATA RATE COMPARISONS

GOES I-M

Current Sensors

GOES R

Sensors

	Raw -Mbps	Processed - Mbps	Raw - Mbps	Processed – Mbps (Uncompressed)
Imager ABI	2.6Mbps		60 Mbps	20Mbps
Sounder/HES	40Kbps		65 Mbps	65Mbps
Additional sensors	-----	-----	5 Mbps	-----
	2.64Mbps	2.1Mbps	130 Mbps	85Mbps

Role of GOES R Data Compression - cont'd

- **GOES** in addition to being a sensor platform; **Serves as a Communications Satellite.**
- GOES down links raw data to the Wallops CDA and backup sites (Greenbelt, MD; Fairbanks, AK)
- Wallops CDA station then uplinks processed data back to GOES, with **GOES globally broadcasting to GOES users within US and foreign countries**
- The Current GOES RF L & S band spectrum allocations **can't handle GOES R data rates**

GOES R Potential RF Spectra and Data Rate Capability

- NESDIS OSD is working to obtain new GOES R era RF Spectrum for Greater Broadcast Capability.
- Coordination with Dept of Commerce NTIA Since July 2001.

Table: Potential New GOES R RF Spectra and Data Rate Capability

	RF Designate	BW	Data Rate Capability Max ¹	Comments
Raw GOES Data down to CDA station				
8215-8400MHz	X	185MHz	500 Mbps ² 300 Mbps ³	16QAM modulation 15/16 code rate
8025-8175MHz	X	150MHz	405 Mbps	16QAM mod 15/16 code rate
18,100-18,300MHz	Ku	200MHz	540 Mbps	
25,500-2,700MHz	Ka	1,200MHz		

GOES R Potential RF Spectra and Data Rate Capability- cont'd

Table Cont'd : [New GOES R Potential RF Spectra and Data Rate Capability- cont'd](#)

GOES R New Spectrum	Band Design	Assumed BW	Maximum Data Rate Capability	Comments
Processed Data Up from CDA to GOES				
7190-7235MHz	X	12 MHz	32Mbps	Limited to 12MHz
8175-8215MHz	X	12 MHz	32Mbps	Limited to 12 MHz
Processed Data Globally Broadcast Down				
1683-1695MHz	L	12MHz	32 Mbps *	16 QAM mod, 15/16 code rate ⁴ . 32 Mbps max data for this BW

- **NESDIS OSD looking to a GRB broadcast limited to 10-24 Mbps because of S/C power & mass Impacts.**

GOES R Potential RF Spectra and Data Rate Capability- cont'd

Table notes:

1. Data rate is a function of BW, Modulation, code rate
2. This is maximum possible data rate
3. Next lower order modulation (8-PSK and a lower order code rate $\frac{3}{4}$) gives data rate capability of 300 Mbps. Technology of both is today more readily available
4. **For global broadcasting, higher order modulation of 16QAM and code rate of 15/16 are potential significant drivers of spacecraft power and mass. This is the reason for the present NESDIS OSD desired limitation of 10-24Mbps on the GOES R GRB broadcast.**

GOES R Data Rate Capabilities

- April 2003 study at the Aerospace Corp's spacecraft Computer Design Center (CDC) in Los Angeles to study optimizing spacecraft power and mass impacts from the communication system modulation, code rates, etc.

From Study Results, OSD Advanced Planning *Presently* Looking at Limiting GOES R Global Broadcast to within **10-24 Mbps**.

Issue: What Would the Global Broadcast Stream of HES and ABI Consist of for a **10-24 Mbps Range, Possibly 32Mbps?**

- Maximum 16 band ABI Estimated at ~20Mbps.